

MECHANICALLY STABILIZED EARTH RETAINING WALLS

The Standard Specifications are revised as follows:

SECTION 105, AFTER LINE 46, INSERT AS FOLLOWS:

When constructing a mechanically stabilized earth retaining wall, the Contractor shall perform the necessary work to verify that the foundation is at the correct elevation, that the wall is constructed to the correct alignment, and that the work is in accordance with the specified tolerances. The checking of alignments and tolerances shall include verifying that the plumbness of the face panels is in accordance with 731.10 over the entire height of the wall. Alignment shall be checked at each layer of panels after the backfill behind the panels has been compacted, and the results shall be recorded.

SECTION 731, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 731 - MECHANICALLY STABILIZED EARTH RETAINING WALLS

731.01 Description. *This work shall consist of furnishing materials and placement of mechanically stabilized earth retaining walls in accordance 105.03.*

731.02 General Design Requirements. *The mechanically stabilized earth wall shall consist of a non-structural leveling pad, concrete face panels, and ground reinforcement elements mechanically connected to each panel. Ground reinforcement shall have sufficient strength, frictional resistance, and quantity as required by design.*

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The mechanically stabilized earth retaining walls system is to be selected from the Department's list of approved Mechanically Stabilized Earth Retaining Walls. The quantities shown in the Schedule of Pay Items will be the same for all mechanically stabilized earth wall systems. All mechanically stabilized earth walls shall be constructed in accordance with the approved plans and panel shop drawings based on the requirements herein. The recommendations of the wall system suppliers shall not override the minimum performance requirements contained herein.

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If the wall manufacturer needs additional information to complete the design, the Contractor shall be responsible for obtaining such information.

All appurtenances behind, in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, or other appurtenances shown on the plans shall be accounted for in the stability design of the wall.

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The mechanically stabilized earth wall design shall follow the general dimensions of the wall envelope shown on the plans. The plans will locate the leveling pad at or below the theoretical leveling pad. The top of the face panel shall be at or above the top of the panel elevation shown on the plans.

Where coping or barrier is utilized, the wall face panel shall extend up into the coping or barrier a minimum of 50 mm (2 in.). The top of the face panels may be level or sloped to meet the top of the face panel line noted. Cast-in-place concrete will not be an acceptable replacement for panel areas noted by the wall envelope.

Where walls or wall sections intersect with an included angle of 130 degrees or less, a vertical corner element separate from the standard panel face shall abut and interact with the opposing standard panels. The corner element shall have ground reinforcement connected specifically to that panel and shall be designed to preclude lateral spread of the intersecting panels.

Face panels shall be designed to accommodate differential settlement of 1 linear unit in 100. Face panels of greater than 3.0 m² (32 sq ft) up through 4.6 m² (50 sq ft) in area shall be designed to accommodate differential settlement of 1 linear unit in 200. Where shown on the plans, slip joints to accommodate excessive or differential settlement shall be included.

731.03 Design Criteria. The design by the manufacturer shall consider the internal and the external stability of the wall mass including the bearing pressure, overturning, sliding, and stability of temporary construction slopes. The design shall be in accordance with the design, construction, and commentary divisions of the AASHTO Standard Specifications for Highway Bridges, unless specified otherwise herein. The analysis of settlement, bearing capacity, and overall slope stability will be the responsibility of the Engineer.

The theoretical failure plane within the soil mass shall be analyzed so that the soil stabilizing component extends sufficiently beyond the failure plane to stabilize the material. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, and slope surcharge, shall be accounted for in the design. The size of all structural elements shall be determined such that the design load stresses do not exceed the allowable stresses found in the AASHTO Standard Specifications for Highway Bridges, unless otherwise shown on the plans.

The maximum allowable yield stress for reinforcement shall be 450 MPa (65,000 psi).

The N angle for the internal design of the volume shall be assumed to be 34 deg. Before construction begins, the Structure backfill selected shall be tested by the Contractor to confirm compliance with the frictional requirement. The wall supplier shall furnish a copy of the testing results for the backfill. The friction angle of the foundation soils shall be assumed to be 30 deg. The N angle of the backfill behind the mechanically stabilized earth mass shall be assumed to be 30 deg.

The wall shall be defined by the wall envelope as shown on the plans. For design purposes, the height of wall H shall be measured from the theoretical top of the leveling pad to the top of the wall. For a level surcharge situation, the top of the wall shall be measured to the top of the coping or to the gutter line of the traffic barrier. The top of the wall shall be the theoretical top of the face panels only when a coping or barrier is not used. For an abutment face, the design height H shall be defined as the height measured from the top of the leveling pad to the top of the roadway surface. For

a wall with a sloping surcharge the top of the wall shall be measured at a point $0.3H$ back from the face where the design height is H and the actual wall height is H .

For aesthetic considerations and to make differential settlement unnoticeable, the panels shall be erected such that the horizontal site line is discontinuous at every other panel. This shall be accomplished by starting erection with the lower panel level of each wall by alternating full height and half height panels. Panels above the lowest level shall be of a standard size except as required to top out the wall to be in accordance with the plan elevations.

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The connections of the ground reinforcing steel to the panels shall be in two elevations for standard panels. The connections shall not be more than 750 mm (30 in.) apart vertically. To prevent out-of-plane rotation, standard face panels shall be connected to ground reinforcement on at least three different points in two different planes. However, preapproved systems utilizing a horizontal stabilizing leg to prevent rotation shall only require ground reinforcement attachments in one plane. Partial panels shall have three different connection points, but only one plane shall be attached to ground reinforcement. Panels, which are located at the top of the wall, shall not be attached to the coping or the traffic barrier.

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The ground reinforcement shall be the same length from the bottom to the top of each wall section whether bar mats, grids, or strips steel are used. Differing ground reinforcement elements shall be clearly marked for ease of construction. This element may be used individually or in a prefabricated grouping. The minimum length of the ground reinforcement shall be 2.5 m (8 ft) or $0.7H$ for a wall without sloping surcharges, $0.7H$ for a wall with sloping surcharges, or in accordance with the AASHTO Standard Specifications for Highway Bridges for an abutment on a spread footing.

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The ground reinforcement for the mechanically stabilized earth volume shall be sized using the lesser of the allowable forces for each specific connection and each specific reinforcing element. The connection's allowable force shall be taken as $2/3$ of the connection test load at the allowable pullout deformation limit of 13 mm ($1/2$ in.) or one half of the ultimate load, whichever is less.

The ground reinforcement length shall be as required for internal design or as shown on the plans. The length shall exceed the minimum noted as required for design consideration. One hundred percent of the ground reinforcement, which is designed and placed in the reinforced earth volume shall extend to and shall be connected to the face panels.

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For mats, grids, or strip steel, the minimum zinc coating thickness shall be 0.64 L/m^2 (2 oz/sq ft). Such thickness shall be assumed to be 86 μm for purpose of calculation of reduced structural section.

The actual applied bearing pressures under the stabilized mass for each reinforcement length shall be clearly indicated on the shop drawings and shall be equal

to or less than the maximum allowable soil pressure shown on the plans. Passive pressure in front of the wall mass will be assumed to be zero for design purposes.

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731.04 Submittals. The Contractor shall submit one copy of the design computations for approval. If the computations are computer generated, one sample set of hand calculations, for one wall location, shall also be submitted. The Contractor shall submit eight sets of design drawings for approval after the design computations are approved and before beginning wall construction operations. Design computations and design drawings shall be signed and sealed by a professional engineer.

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(a) The design drawings shall include all details, dimensions, quantities and cross-sections necessary to construct the wall and shall include but shall not be limited to the following:

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1. A plan and elevation sheet or sheets for each wall
2. An elevation view of the wall which shall include the elevation at the top of the wall at all horizontal and vertical break points at least every 15 m (50 ft) along the face of the wall, all steps in the leveling pads, the designation as to the type of panel, the length of soil reinforcing systems, the distance along the face of the wall to where changes in length of the soil reinforcing systems occur, and an indication of the original and final ground lines and maximum bearing pressures
3. A plan view of the wall that indicates the offsets from the construction centerline to the face of the wall at all changes in horizontal alignment. A plan view and elevation view which detail the placing position and connection of all steel ground reinforcing elements in areas where piling, utility, or other structures are near the wall.
4. A typical cross section or cross sections showing elevation relationship between ground conditions and proposed grades
5. All general notes required for constructing the wall
6. All horizontal and vertical curve data affecting the wall
7. A listing of the summary of quantities on the elevation sheet for each wall

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(b) All panel details shall show all dimensions necessary to construct the element, all reinforcing steel in the element, and the location of soil reinforcing system devices embedded in the panels.

(c) *Clearly indicated details for construction of walls around drainage facilities.*

(d) *All details of the architectural treatment.*

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(e) *The details for diverting strips or mesh around obstructions such as piles, catch basins, and other utilities shall be submitted for approval.*

(f) *The details for each connection between the concrete panel and the mesh or strip.*

Shop drawings, design calculations, and design drawings shall be submitted to the Engineer for review and approval.

MATERIALS

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731.05 Materials. *The Contractor shall make arrangements to purchase the materials described herein, including concrete face panels, retaining strips or mesh, tie strips, fasteners, joint materials, and all necessary incidentals, from an approved mechanically stabilized earth wall system manufacturer. The Contractor shall make arrangements with the Materials and Tests Division for all required offsite testing.*

Materials shall be in accordance with the following:

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<i>B Borrow</i>	<i>211.02</i>
<i>Coarse Aggregate, Class A or Higher, Size No. 8 or 91 ..</i>	<i>904</i>
<i>Concrete Admixtures</i>	<i>912.03</i>
<i>Concrete, Class A.....</i>	<i>702</i>
<i>Fine Aggregate, Size No. 23.....</i>	<i>904</i>
<i>Fly Ash.....</i>	<i>901.02</i>
<i>Portland Cement.....</i>	<i>901.01(b)</i>
<i>Reinforcing Steel</i>	<i>910.01</i>
<i>Structure Backfill *.....</i>	<i>904</i>
<i>Water</i>	<i>913.01</i>

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** Slag will not be allowed.*

Structure backfill shall have a minimum resistivity of 3000 Σ cm at 100% saturation when tested in accordance with AASHTO T 288. The pH of the backfill material shall be in the range of 5 to 10 as determined in accordance with AASHTO T 289. The maximum soluble salt content of the backfill material shall not exceed 100 ppm chlorides and 200 ppm sulfates as determined in accordance with AASHTO T 291 and AASHTO T 290, respectively. If the minimum resistivity exceeds 5000 Σ cm at 100% saturation, the requirement of testing for chlorides and sulfates may be waived.

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(a) Concrete Face Panels. *Concrete shall be in accordance with the applicable requirements of 702. Concrete shall have a compressive strength of 27.5 MPa (4000 psi) at 28 days.*

Retarding agents, accelerating agents, or additives containing chloride shall not be used without approval. Air-entraining and slump requirements shall be in accordance with 702.05.

Ground reinforcement connecting hardware and rebar lifting devices shall be set in place and secured prior to beginning casting, in accordance with the dimensions and tolerances shown on the plans.

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1. Testing and Inspection. *Acceptability of the panels will be determined on the basis of compressive strength tests and visual inspection. The panels shall be considered acceptable regardless of curing age when compressive test results indicate that the compressive strength is in accordance with 28-day requirements. Panels utilizing type I or II cement will be considered acceptable for placement in the wall when 7-day initial strengths exceed 85% of the 28-day requirements. Panels utilizing type III cement will be considered acceptable for placement in the wall prior to 28 days only when compressive strength test results indicate that the strength exceeds the 28-day requirements.*

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2. Casting. *The panels shall be cast on a flat area, with the front face of the form at the bottom, and the back face at the upper part. Tie strip guides shall be set on the rear face. The concrete in each unit shall be placed without interruption and shall be consolidated by the use of an approved vibrator, supplemented by such hand tamping as may be necessary to force the concrete into the corners of the forms and prevent the formation of stone pockets or cleavage planes. Clear form oil of one manufacture shall be used throughout the casting operation.*

3. Curing. *The panels shall be cured for a sufficient length of time such that the concrete develops the specified compressive strength.*

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4. Removal of Forms. *The forms shall remain in place until they may be removed without damage to the unit.*

5. Concrete Finish. *The concrete surface for the front panel face shall have a surface finish produced from contact with the form. The rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of 6 mm (1/4 in.).*

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6. Tolerances. *All panels shall be manufactured within the tolerances as follows:*

a. Panel Dimensions. *Lateral position of tie strips shall be within 25 mm (1 in.). All other dimensions shall be within 5 mm (3/16 in.).*

b. Panel Squareness. *Squareness, as determined by the difference between the two diagonals, shall not exceed 13 mm (1/2 in.).*

270 *c. Panel Surface Finish. Surface defects on smooth formed surfaces measured on a length of 1.5 m (5 ft) shall not exceed 3 mm (1/8 in.). Surface defects on textured finished surfaces measured on a length of 1.5 m (5 ft) shall not exceed 5 mm (5/16 in.).*

7. Compressive Strength. Acceptance of the concrete panels with respect to compressive strength will be determined on the basis of production lots. A production lot will consist of a single days production of concrete panels.

280 *During the production of the concrete panels, the Engineer will sample the concrete in accordance with AASHTO T 141. A single compressive strength sample, consisting of a minimum of four cylinders, will be randomly selected from each production lot.*

Cylinders for compressive strength tests shall be prepared in accordance with AASHTO T 23 on specimens of 150 mm x 300 mm (6 in. x 12 in.). For each compressive strength sample, a minimum of two cylinders will be cured in the same manner as the panels and tested at seven days. The average compressive strength of these cylinders, when tested in accordance with AASHTO T 22, will provide a test result that will determine the initial strength of the concrete. In addition, two cylinders will be cured in accordance with AASHTO T 23 and tested at 28 days. The average compressive strength of these two cylinders, when tested in accordance with AASHTO T 22, will provide a compressive strength test result that will determine the compressive strength of the production lot.

300 *If the compressive strength test result is less than 27.5 MPa (4000 psi), retesting will be permitted and will be based on four cores taken from the panels within the production lot. The Engineer will randomly select four panels within the lot for testing. The Contractor shall obtain cores in the presence of the Engineer with a device to produce cores for testing in accordance with AASHTO T 24. The average of the four-retest cores will determine the final compressive strength of the production lot. A production lot which is not in accordance with the compressive strength requirements will be considered and adjudicated as a failed material in accordance with normal Department practice as listed in 105.03.*

If the initial seven day strength test results exceed the compressive strength requirements then the testing at 28 days will be waived for that particular production lot.

310 *8. Rejection. Units shall be subject to rejection due to failure to be in accordance with the requirements specified above. In addition, the following defects may be sufficient cause for rejection:*

a. Defects which indicate imperfect molding

b. Defects which indicate honeycombed or open texture concrete

- c. *Defects in the physical characteristics of the concrete, such as broken or chipped concrete, or color variations or dunnage marks on the front face due to excessive form oil or other reasons.*

320 *The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if permitted, shall be completed in a satisfactory manner. Repair to concrete surfaces that are to be exposed to view after completion of construction shall be subject to approval.*

9. Marking. *The date of manufacture, the production lot number, and the place mark shall be clearly scribed on the rear face of each panel.*

330 **10. Handling, Storage, and Shipping.** *All panels shall be handled, stored, and shipped so as to eliminate the danger of chipping, cracks, fractures, and excessive bending stresses. Panels in storage shall be supported on firm blocking located immediately adjacent to tie strips to avoid bending the tie strips.*

(b) Concrete Leveling Pad. *Concrete, Class A, for the leveling pad shall be placed in accordance with the applicable requirements of 702.*

340 **(c) Concrete Coping.** *Concrete, Class A, for the coping shall be in accordance with the applicable requirements of 702. Reinforcing steel in the coping shall be in accordance with the applicable requirements of 703. The coping may be precast or cast in place.*

(d) Reinforcing Mesh, Clevis Connector, and Connector Bar. *The reinforcing mesh shall be shop fabricated of cold drawn steel wire in accordance with ASTM A 82 and shall be welded into the finished mesh fabric in accordance with ASTM A 185. Galvanization shall be in accordance with ASTM A 123.*

350 *Clevis connectors, if used, shall be attached to the alignment templates using the bars provided with the forms. The vertical and horizontal alignment of the connectors shall be +3 mm (+1/8 in.). The holes inside the loops shall be free of all concrete and debris, loose or otherwise.*

The clevis connector shall be fabricated of cold drawn steel wire in accordance with ASTM A 82 and welded in accordance with ASTM A 884. Loops shall be galvanized in accordance with ASTM A 153 Class B-3 or ASTM A 123.

The connector bar, if used, shall be fabricated of cold drawn steel wire in accordance with ASTM A 884 and galvanized in accordance with ASTM A 123.

360 *A type A certification in accordance with 916 for reinforcing mesh, clevis connector, and connector bars shall be furnished prior to use of the materials.*

(e) Ground Reinforcement. *The ground reinforcement may be a deformed steel strip or a welded wire grid. The grid or strip used shall be consistent with that used in the pullout test and shall be consistent throughout the project.*

370 *The grid shall consist of not less than two longitudinal wires, perpendicular to the wall, welded to equally spaced cross ribs capable of developing passive pressure with the fill. The deformed strip shall be of constant width. The strip thickness shall vary only from the standard underformed section to the standard deformed section as required to produce the pullout resistance.*

All longitudinal wires of each welded wire grid shall be of the same diameter. All transverse wires of each welded wire grid shall be of the same diameter, but not necessarily the same as the longitudinal wire diameter.

The face panel edges shall be configured to conceal the joints. All horizontal and vertical joints shall be covered with a joint cover to prevent backfill leakage while passing water.

380 *Reinforcing strips shall be hot rolled from bars to the required shape and dimensions. Physical and mechanical properties of the strips shall be in accordance with ASTM A 572M Grade 450 (A 572 Grade 65). Tie strips shall be shop fabricated with hot rolled steel in accordance with the minimum requirements of ASTM A 709M Grade 345 (A 570 Grade 50). Galvanization for reinforcing strips and tie strips shall be in accordance with ASTM A 123. All reinforcing strips and tie strips shall be inspected to ensure that they are true to size and free from defects which may impair their strength and durability.*

390 *A type A certification in accordance with 916 for ground reinforcement shall be furnished prior to use of the materials.*

(f) Reinforcing Steel. *Mill certificates for reinforcing steel as shown on the plans shall be furnished for approval. All reinforcing steel shall be in accordance with ASTM A 709M Grade 400 (A 615 Grade 60).*

A type A certification in accordance with 916 for reinforcing steel shall be furnished prior to use of the materials.

400 **(g) Fasteners.** *Fasteners shall consist of 13 mm (1/2 in.) diameter, hexagonal cap screw bolts and nuts, which shall be galvanized and in accordance with ASTM A 325M (A 325).*

A type A certification in accordance with 916 for fasteners shall be furnished prior to use of the materials.

(h) Alignment Pins. *The rods used to align the face panels during construction shall be 19 mm (3/4 in.) diameter, 300 mm (12 in.) long. The rods shall*

be mild steel, polyvinyl chloride, or fiberglass. A sample shall be submitted prior to use to the Materials and Tests Division for approval.

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(i) Joint Materials. Bearing pads shall be rubber, neoprene, polyvinyl chloride, or polyethylene, and of the type and grade recommended by the supplier of the mechanically stabilized earth wall system.

The joint cover shall be either a non-woven needle punch polyester geotextile or a woven monofilament polypropylene. The joint cover shall be attached to the rear face of the panels with a suitable adhesive.

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Horizontal and vertical joints shall be provided between adjacent face panels to prevent concrete-to-concrete contact and chipping when differential settlement occurs. The horizontal and vertical joints shall contain compression blocks, pins, or other approved means as recommended by the manufacturer to provide a uniform joint. Panels without an uninterrupted vertical joint shall have a minimum joint thickness of 19 mm (3/4 in.).

(j) Backfill Material. Material used in the mechanically stabilized earth wall volume shall be structure backfill.

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A type A certification in accordance with 916 for structure backfill shall be furnished prior to use. One copy of all test results performed by the Contractor, which are necessary to demonstrate compliance with the specifications, shall be furnished.

CONSTRUCTION REQUIREMENTS

731.06 General Requirements. The wall supplier representative shall provide technical instruction, guidance in pre-construction activities including the preconstruction conference, and on-site technical assistance to the Contractor during construction.

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731.07 Foundation Preparation. The foundation for the structure shall be graded level for a width equal to or exceeding the length of the reinforcing strips or as shown on the plans. Prior to wall construction, the foundation, if not in rock, shall be compacted in accordance with 203. The base of the wall excavation shall be proofrolled with a vibratory roller weighing no less than 9 Mg (10 t), or with other approved compacting equipment. If unsuitable foundation material is encountered, it shall be removed and replaced with B borrow in accordance with 211.02 and compacted in accordance with 211.04.

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At each foundation level, an unreinforced concrete leveling pad shall be provided as shown on the plans. The leveling pad shall be cured in accordance with 702.22 a minimum of 12 h before placement of concrete face panels.

731.08 Retaining Wall Excavation. This work shall consist of the excavation of material whose removal is necessary for the construction of the mechanically stabilized

earth walls in accordance with the plans, the requirements herein, or as directed. Excavation shall include the construction and subsequent removal of all necessary bracing, shoring, sheeting; and cribbing and all pumping, bailing, and draining.

460 *Prior to starting excavation operations at the wall site, clearing and grubbing shall be in accordance with 201.03. The Contractor shall clear and grub the area to the excavation in accordance with the limits shown on the plans. All timber, stumps, and debris shall be disposed of in accordance with 201.03.*

The Contractor shall notify the Engineer a sufficient time before beginning the excavation so that measurements may be taken of the undisturbed ground.

470 *Where necessary for safety, the excavation shall be shored or braced in accordance with State and local safety standards. Excavation and related work shall be performed such that no portion of the wall is endangered by subsequent operations.*

Where excavation for the wall is adjacent to a traveled way, the method for shoring, sheeting, or bracing the excavation opening shall have been approved before beginning the excavation. The Contractor shall submit five copies of drawings in accordance with 206.09 showing details of the proposed method of excavation protection.

480 *After the excavation for each wall location has been performed, the Contractor shall notify the Engineer. Concrete for the leveling pad shall not be placed until the Engineer has approved the depth of the excavation and the foundation material.*

All sheeting and bracing shall be removed as the random backfilling progresses.

All material for random backfill shall be subject to approval and shall be free from large or frozen lumps, wood, or other undesirable material. All backfill shall be compacted in accordance with 203.

490 **731.09 Wall Erection.** *Concrete face panels shall be handled by means of a lifting device set into the upper edge of the panels. Panels shall be placed in successive horizontal lifts in the sequence shown on the plans as backfill placement proceeds. As backfill material is placed behind the panels, the panels shall be maintained in vertical position by means of temporary wooden wedges placed in the joint at the junction of the two adjacent panels on the external side of the wall. External bracing will be required for the initial lift.*

Panels placed in contact with the ground or covered by standing water shall have face discoloration removed by means of a chemical wash. Panels shall be stored on blocking to minimize contact with the ground or being covered by standing water.

500 *Plumbness, vertical tolerances, and horizontal alignment tolerances shall not exceed 19 mm (3/4 in.) when measured with a 3 m (10 ft) straightedge. The maximum allowable offset in panel joints shall be 19 mm (3/4 in.). The overall plumbness from*

top to bottom to the wall shall not exceed 13 mm per 3 m (1/2 in. per 10 ft) of wall height.

Reinforcing strips shall be placed normal to the face of the wall, unless otherwise shown on the plans or as directed. Prior to placement of the reinforcing strips, backfill shall be compacted in accordance with 731.10.

510 ***731.10 Backfill Placement.** Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed so as to avoid damage or disturbance to the wall materials or misalignment of the concrete face panels. Wall materials that become damaged or disturbed during backfill placement shall be removed and replaced or corrected as directed. All misalignment or distortion of the concrete face panels due to placement of backfill outside the limits described herein shall be corrected as directed.*

520 *The work shall also include B borrow backfilling above a theoretical 1:1 slope behind the ground reinforcement in accordance with the details shown on the plans and the disposal of surplus of unsuitable excavated materials as permitted.*

Structure backfill shall be compacted to 95% of the maximum dry density in accordance with AASHTO T 99. Compaction equipment shall be in accordance with 409.03(d). Density of the compacted aggregate will be determined in accordance with 203.24(b).

530 *The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill material shall have placement moisture content between optimum and -3 of the optimum moisture content. Backfill material with placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable through the entire lift.*

The maximum loose lift thickness shall not exceed 200 mm (8 in.) except that lifts 1 m (3 ft) from the wall or closer shall not exceed 125 mm (5 in.) in loose thickness. This lift thickness shall be decreased if necessary, to obtain the specified density.

540 *Compaction within 1 m (3 ft) of the back face of the concrete face panels shall be achieved by means of a minimum of three passes with a lightweight mechanical tamper, roller, or an alternative vibratory system.*

At the end of each day's operation, the last level of backfill shall be sloped away from the concrete face panels. In addition, surface runoff from adjacent areas shall not be permitted to enter the wall construction site.

Cutting or altering of the basic structural section of either the strip or grid at the site will be prohibited, unless the cutting is preplanned and detailed on the approved design drawings. Cutting shall only be considered if adequate additional steel is

550 provided to produce the required ground reinforcement strength shown in the approved calculations. If the grid or strip is shortened in the field, the cut ends shall be covered with a galvanized paint or Bitumastic 50 coal tar to prevent corrosion of the metal.

731.11 Method of Measurement. Concrete face panels and wall erection will be measured by the square meter (square foot) of wall surface area. Cast-in-place concrete for the leveling pad will be measured by the meter (linear foot). Structure backfill and B borrow will be measured in accordance with 211.09. Unsuitable foundation materials, if found, will be measured in accordance with 211.09.

560 The pay quantities for concrete face panels, wall erection, and concrete leveling pad will be based on the neat line limits of the wall envelope as shown on the plans and not that of the wall system supplier. The wall envelope limits will be considered to be the vertical distance from the top of the leveling pad to the top of the coping, and the horizontal distance from the beginning to the end of the leveling pad.

731.12 Stockpiled Concrete Face Panels. Partial payment will be made for panels stockpiled on the project site or at the Contractor's approved storage location. Partial payment will be based on the delivered cost of the wall panels, as verified by invoices that include freight charges. The Contractor shall furnish the invoices. The partial payment will not exceed 75% of the contract unit price for concrete face panels.
570 Prior to authorizing partial payment, the Engineer will verify that the panels are in accordance with 731.05(a).

731.13 Basis of Payment. Concrete face panels and wall erection will be paid for at the contract unit price per square meter (square foot). The concrete leveling pad, complete and in place, will be paid for at the contract unit price per meter (linear foot) for leveling pad. Structure backfill and B borrow will be paid for at the contract unit price per cubic meter (cubic yard) in accordance with 211.10. Unsuitable foundation materials will be paid for in accordance with 211.10.

580 Payment will be made under:

Pay Item	Metric Pay Unit Symbol (English Pay Unit Symbol)
Face Panels, Concrete	m2 (SFT)
Leveling Pad, Concrete	m (LFT)
Wall Erection	m2 (SFT)

590 The cost of all mechanically stabilized earth wall materials including concrete face panels, reinforcing strips, tie strips, fasteners, joint materials, coping, repair or replacement of face panels damaged or removed due to backfill placement, and incidentals shall be included in the cost of concrete face panels.

The cost of all labor and materials required to prepare the wall foundation, place the reinforcing strips, and erect the concrete face panels shall be included in the cost of wall erection.

The cost of retesting failed concrete face panels will be included in the cost of concrete face panels.

600 *The cost of all excavation required shall be included in the costs of other pay items.*
